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Original Research Paper

Detection of Organic Materials in Fly Ash by Chromatographic Method

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ABSTRACT

Fly ash, a by-product from coal based power plants is composed of totally inorganic and inert substances and is unsupportive for life forms. Fly ash in Korba is dumped into special open embankments called dykes. The search for organic materials was important because formation of humus is a revolution in fly ash, then only it will be able to support life forms. This was done in these dykes to confirm the source of organic materials in fly ash, i.e., whether they are coming from the coal, the start up oil of the furnace or from the animals and plants coming up in the area. The method used was thin layer chromatography and ascending paper chromatography in liquid medium.

INTRODUCTION

Fly ash is composed of mostly very fine particles, finer than cement. Majority of the particles are like glass spheres. The predominant constitution in fly ash is inert mineral oxides, approximately 95% of which are made of silicon, aluminium, iron and calcium and their oxide forms and some crystalline phases formed during cooling. The type and proportion of trace elements in fly ash are highly variable. The property of fly ash depends mainly on the type of coal being burnt. In the process, many properties of coal change. In comparison of coal and fly ash amounts of hydrogen and nitrogen were found to be similar but sulphur content in Springfield fly ash as compared to Danville fly ash was twice as high. Mercury, however, in fly ash was 15 times lower than coal . The fly ash in Korba is produced from bituminous coal and according to Tiwari (2007) contains materials like silica, alumina, iron oxide, calcium oxide, magnesium oxide, and sulphate. ~

When the fly ash is dumped in ash dykes, its totally inorganic strata is unsupportive for life. The dyke is sprayed by water from time to time to restrict air pollution. This water, sometime, takes time in drying and forms small pools or puddles on the dykes. This initiates the natural process of introduction of animal and plant life from outside the area or we can say that succession starts. The succession in these dykes has been discussed earlier by Shrivastava (2003). It is very natural that plants and animals of the surroundings of the dykes make their presence felt in the dykes, though their life span is not much. The life in these dykes of Korba starts in the rainy season and on the onset of summer every life form dies. This cycle is repeating itself for more than 10 years. Thus, the dyke can be divided in two regions, 1. where there is plantation at some time of the year, and 2. where there has never been a plantation.

It is very much obvious that in those parts where the plantation and animals were present, their dead parts and excretory materials would have turned into humus. But those parts where there was no life, it is not sure that they also contain humus or any other organic material. The search of organic material in fly ash is more important because fly ash is coming straight from coal where carbon is an

organic material. Some fly ash from boilers that burn oil during start up periods may have some residual oil in it. The strongest assumption is that the organic material is being formed in the area where life forms are present.

MATERIALS AND METHODS

Five ash dykes were selected from Korba, which harbour some life in them. The dykes, which are being used by the power plant for plantation and reclamation were not included in the study because for these purposes the power plant company amends the fly ash substratum by adding soil and fertilizers, thus, the study of these area will not show the qualities of ash alone. Hence, the work was done on the areas where there was no amendments in the soil, no interference of any other type from the workers, etc. The dykes occupy vast areas as much as 50 acres of land, and there are six such dykes in Korba, so it was easy to find barren and uninterrupted areas in dykes. The methods used for detection of organic matter include thin layer chromatography and paper chromatography (ascending method.

RESULTS AND DISCUSSION

A. Thin Layer Chromatography Method

Fly ash from barren areas of dyke: First of all, a concentrated solution was prepared in water and ethyl alcohol (50:50). The chromatographic glass plate taken was about 5 × 1.5 inch activated at 60-70 °C. The spotting of concentrated solution was done only after the slide gained the room temperature. The chromatogram was run in iodine chamber. No spotting was obtained confirming the absence of organic materials (Table 1).

Fly ash from areas where live forms existed: Same method was repeated with this ash, but with low polarity. Prominent spots were obtained confirming the presence of organic materials (Table 1).

B. Paper Chromatography

The concentrated solution of fly ash was spotted on chromatography paper. After the spot dried, the paper was fixed in chromatographic chamber with eluent in the chamber. After the eluent runs almost to top of the paper, it was taken out, dried and kept in iodine chamber, and then sprayed with ninhydrin solution. No spots were observed, confirming the absence of any organic material (Table 2).

Due to its shape and size, the characteristics of fly ash is that of high surface area to volume ratio with solids that have agglomerated materials on its surface. In general, the composition of spherical portion of it is immune to dissolution due to glassy structure. The nature of spherical portions is quite inert. However, on the surface of the spheres exists either easily exchangeable or adsorbed molecules which in presence of liquid become dissolved and ultimately produce leachates.

Thin layer chromatography method has been repeatedly used by scientists in biological fields (Nema & Shrivastava 1991a,b). The chromatographic-enzyme inhibition method using paper and thin layer chromatography were developed for detection of heavy metal compounds like mercuric chloride, copper sulphate, cadmium sulphate and silver nitrate with mammalian liver succinate dehydrogenases as biovector and for zinc sulphate (Seethamma & Nandakumar 2007). Thus, by these experiences, chromatography was selected as the best method for detection of presence of organic materials.

The presence of life forms in fly ash dykes has been earlier reported by Shrivastava (2006). It is

Table 1: Presence of organic matter in dykes by TLC method.

	Samples of fly ash	Method of testing	observation	Result
1.	From barren area of the dyke Dyke-1 Dyke-2 Dyke-3 Dyke-4 Dyke-5	TLC	No spots were found on TLC plate	Organic materials absent
2.	From the areas where plantation was present Dyke-1 Dyke-2 Dyke-3 Dyke-4 Dyke-5	TLC	Clear spots were observed on the plate	Organic materials present

Table 2: Presence of organic matter in dykes by paper chromatography method.

	Samples of fly ash	Method of testing	observation	Result
1.	From barren area of the dyke Dyke-1 Dyke-2 Dyke-3 Dyke-4 Dyke-5	Paper chromatography	No ninhydrin stains observed on the chromatographic paper	Organic materials absent
2.	From the areas where plantation is present Dyke-1 Dyke-2 Dyke-3 Dyke-4 Dyke-5	Paper chromatography	Clear spots were observed on the chromatographic paper	Organic materials present

clear that the life forms exist mostly on the periphery where there is maximum contact with the outside area with maximum stagnation of water, while the central areas of dyke do not have life forms as reported by Shrivastava (2007) by macro and micro examinations. Thus, by these chromatographical methods, it is confirmed that the areas where the life forms were present at any time of the year have the organic materials but all other barren parts were devoid of any organic materials. The presence of organic materials in the fly ash is also confirmed by the study of Kunlei Liu et al. (2000), which indicated that majority of polycyclic aromatic hydrocarbons in the solid phase are derived from breakdown reactions during combustion or pyrolysis in a fluidized bed combustion system. The total number of PAHs in fly ash was found much higher than that in raw coal and gas phase. The presence of organic material in fly ash, derived through plant material, is also confirmed by the study of Chabbi (2004).

The presence of organic materials in the totally inorganic fly ash is a big step towards the starting of a self sustaining substratum, because in the cycle of succession the substratum changes step by step, thus, making it possible for the variety of life forms to acclimatize themselves.

As we know fly ash is a true combusised part of charcoal which is the main source of hydrocar-

bons (organic material), but if it does not contain organic material it indicates that it is completely combusised and hence all C present in the charcoal has been removed as CO_2 during combustion. The surface fly ash is far from the underneath soil, thus, no exchange of any material from it is taking place towards the fly ash upwards, therefore, no organic material from soil is present there. The leaching from the fly ash towards the ground is still possible.

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